light variability, the discoverer of variability of radial velocity, and the authority for the orbital elements given.

It is with pleasure that I acknowledge my indebtedness to Director CAMPBELL, who placed at my disposal the necessary instruments, and who also aided me with advice and encouragement; to Messrs. WRIGHT, MOORE, and ALBRECHT for various suggestions in discussing the hypotheses regarding stellar variability; to Professor CRAWFORD, of Berkeley, who verified the mathematical work; and to Misses HOBE and ALLEN, who performed a part of the computation.

J. C. DUNCAN.

MT. HAMILTON, May 25, 1909.

THE ORBIT OF THE *CEPHEID* VARIABLE STAR X *SAGITTARII*.[1]

The variable brightness of X *Sagittarii* was discovered by SCHMIDT in 1886. Its variability was soon recognized to be similar in type to that of δ *Cephei*, characterized by a regular and continuous change in light, and the inequality of the intervals from maximum to minimum and minimum to maximum.

The variable radial velocity of X *Sagittarii* was detected by Mr. V. M. SLIPHER[2] from his measures of the plates of June 19 and 22, 1904. A series of spectrograms of this star was secured at the Lick Observatory in August, September, and October, 1904, with the one-prism spectrograph equipped with a light 60° prism.[3] The period being so nearly commensurable with a day, these observations were sufficient to determine only seven points of the curve. It was then necessary to wait until the summer of 1905 before observations at intermediate points of the curve could be secured. When the 1904 and 1905 series were measured and reduced by the method described by Mr. R. H. CURTISS[4] it was found that the accordance of the observations, using all of the plates, was not satisfactory, due to differences in exposure, combined with

[1] A detailed account of this investigation will be found in *Lick Observatory Bulletin*, 157, **5**, 111, 1909.

[2] *Lowell Observatory Bulletin*, **11**, 1904, and *Astrophysical Journal*, **20**, 146, 1904.

[3] For a description of the one-prism instrument, see Mr. R. H. CURTISS's article, *Lick Observatory Bulletin*, **3**, 19, 1904.

[4] *l. c.*

the poor character of the lines in the star spectrum. Accordingly a series of ten plates was secured, in the summer of 1908, with the Mills spectrograph (three-prism), using a slit-width of 0.05^{mm} (which is about 0.010^{mm} to .014^{mm} wider than is used in the regular observing with this instrument), and the very rapid Lumière Σ plates. With the exception of one plate, which was badly underexposed, the three-prism series was capable of accurate measurement.

The final procedure was to measure only the best plates taken with one prism (the 1904 and 1905 series) and the new series of three-prism plates.

After a number of trials the following elements were decided upon as giving the best representation of the observations:

$$U = 7.01185 \text{ days (assumed)}$$
$$\mu = 51°.342$$
$$e = 0.40$$
$$\omega = 93°.65$$
$$T = \text{J. D. } 2416723.05$$
$$a \sin i = 1{,}334{,}000^{km}$$
$$V = \text{velocity of system} = -13.50^{km}$$

The epoch of greatest velocity of approach is 0.28 day later than the time of light maximum. The close agreement of the times of light maximum and of the greatest velocity of approach is a fundamental characteristic of all variables of the *Cepheid* type, as pointed out by Mr. ALBRECHT.[5] There seems to be no close connection in the case of X *Sagittarii* between the time of minimum light and that of the greatest velocity of recession, the minimum in the light-curve preceding the time of greatest positive velocity by about 1.7 days. This connection does not appear, however, to be such a close one as that for maximum light and greatest negative velocity in the case of other *Cepheid* variables. The smooth character of the light- and velocity-curves of X *Sagittarii* is worthy of note. Evidently if any irregularities exist in either, they are quite small.

J. H. MOORE.

MT. HAMILTON, April 19, 1909.

[5] *Lick Observatory Bulletin*, **4**, 130, 1907.